Wind generator output 2400 W (2.4 kW)
b monthly 90 kWh daily 3 kWh

Batteries hold power for 4 days, ~ 12 kWh

DC → inverter → AC → appliances

- Appliance Package(s)
  - Basic + Climate option + Family Size option
  - Describe how each appliance contributes to the well being of residents
  - Decide what appliances <u>can</u> and <u>should</u> be used to meet residents' basic needs
- Education
  - How much/often they can use appliances
    - can't exceed 2400 W at one time
    - can't exceed 3 kWh total per day

- Wiring diagram – Extra Credit

Appliance Pkg.

5 How much W/kW
≥ 3 used to run (list)
Include outside research (if done)

up to 10 Options 5 ea pkg

Physics principles
2pts ea

≥ 5

and/or

Education

10pts
How much to use
How often
What not to use together

Physics principles

35pts

Chapter 6 Teams

Aneya

Sandra
Melissa
Obsession

Breanna
Jessica
Jennifer
Sabrina
Cinthia

6.1 Generating Electricity p. 598 10/13

WDYS

A dog holding a light bulb and a light socket - trying to figure out how to connect the wires to light the bulb, + & - wires connected to a hand crank generator - evening
Dog & prarie dog are curious

WDYT

Burn trash, store energy in wires, wires sent to green energy boxes, more wires ~~take~~ energy to homes

Wind	Trash	Methane	Muscle power
Water	Wax	Gasoline	Diesel
Solar	Solid waste	Coal	Corn / Sugar Cane
Geothermal	Natural gas	Wood	Petroleum

Forms of energy

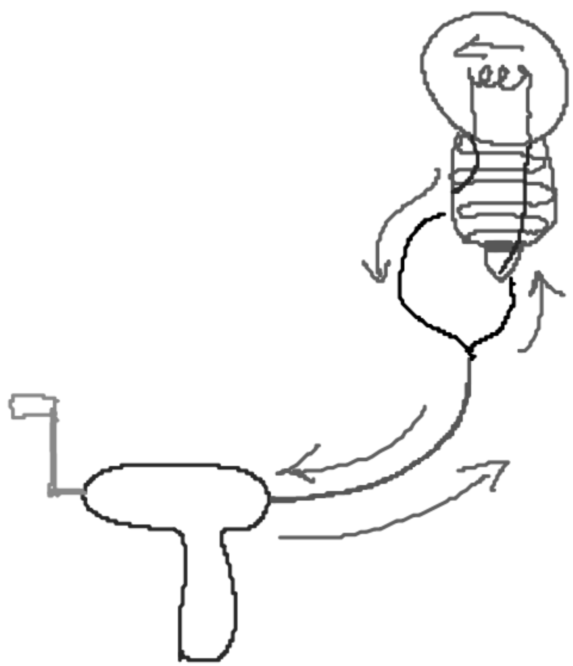
1 food / Chemical

2 Muscles / Kinetic

3 turn crank / Mechanical

4 electrical

5 light + heat



Physics Talk

10/17

How does an electrical circuit work?

- Closed circuit / loop
- blinky bulb turned off - hand generator got looser, no power needed (opened circuit)

How do energy transformations light a bulb?

- Chemical - mechanical - electrical - light + heat
- big generators use non-human sources

How does a lightbulb work?

- two terminals - one wire for each
- two terminals - metal screw threads + tip
- filament glows when electricity flows through

p. 601 Checking Up #1-3

p. 602 WDYTN

p. 603 What does it mean?

pp. 604-605 PtG #1, 3-6, 10

6.2 Modeling Electricity: The Electron Shuffle

10/18

WDYS

Kids running in a circle taking pretzels from one guy and giving them to another

- Circle person's shirt says "Pretzel Power"
- pretzels make receiver hyper (light bulb on shirt)
- Closed circle models a closed circuit

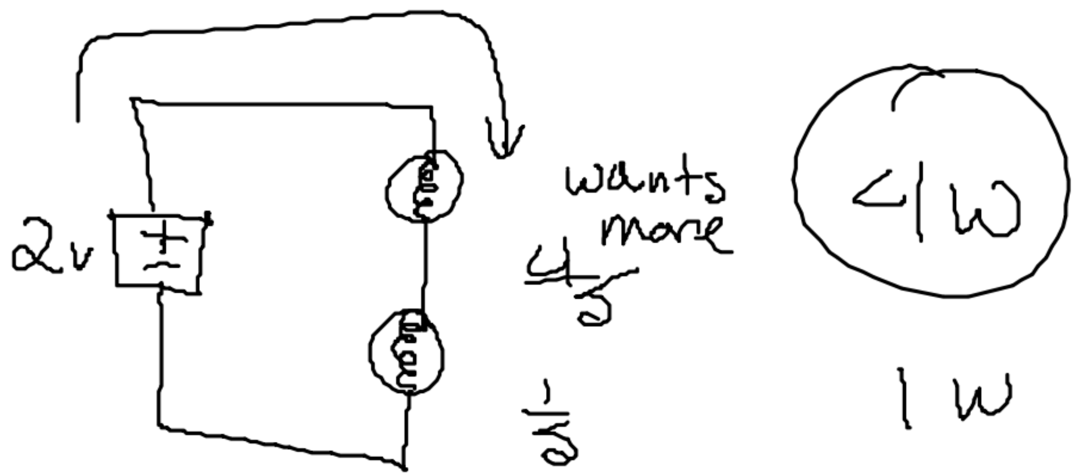
WDYT

more pretzels (Joules) = more excitement

more amperage = walk faster

$$\text{amperage} = \frac{\text{pretzels}}{\text{sec}}$$

Voltage 1 V = 1 pretzel at a time



Physics Talk

10/24

How do you model an electrical circuit?

20A

15A

- energy is used up, the electric charge is not used up
- stored energy is potential energy
  - electric potential
- resistors (light bulb, wires)
  - give off light or heat
- Current - rate of flow
  - amperes (amps) $A = \frac{C}{s}$
- Voltage - energy per unit of charge - volts $V = \frac{J}{C}$
- Coulomb - unit of charge C
  - ~6.25×10^{18} electrons

What is a series Circuit?	• the electric current has only a single path to follow • the current is the same throughout the circuit • the total voltage provided to the resistors is equal to the voltage of the battery • Watts – power $W = \frac{J}{s}$ • increasing the brightness of a bulb – ↑ V – ↑ A or both

p. 610 CU 1-4
p. 611 WDYTN
pp. 612-613 PtG 1-3

6.3 Series and Parallel Circuits: Lighten Up p. 614 10/25

WDYS

Same pictures – 1 w/ lights on, 1 w/ lights off
girl removes light bulb + all lights go out (all 4)
girl on ladder, moon outside

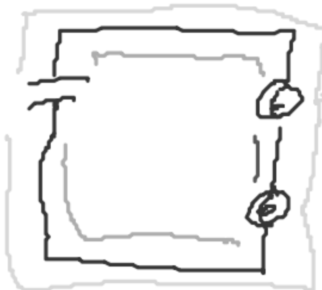
WDYT

Yes, they stay lit.

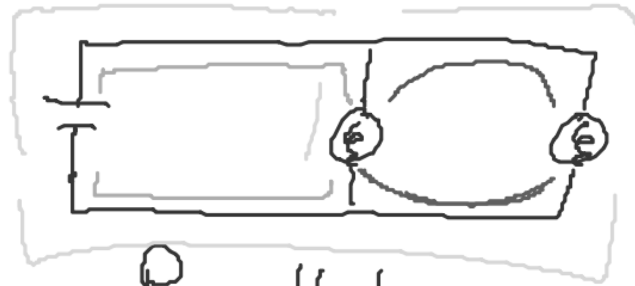
Different circuits

Each light has its own wire connected
to some source of power

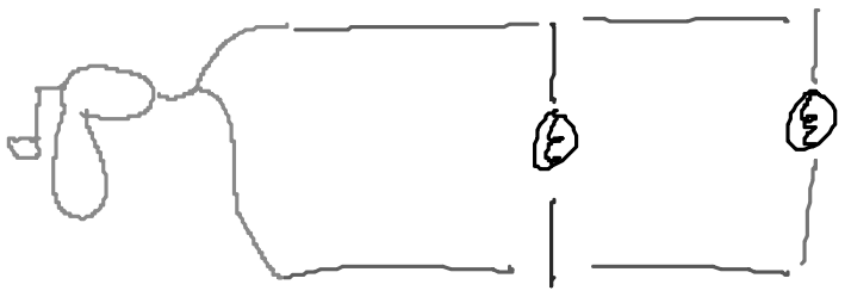
Parallel circuit

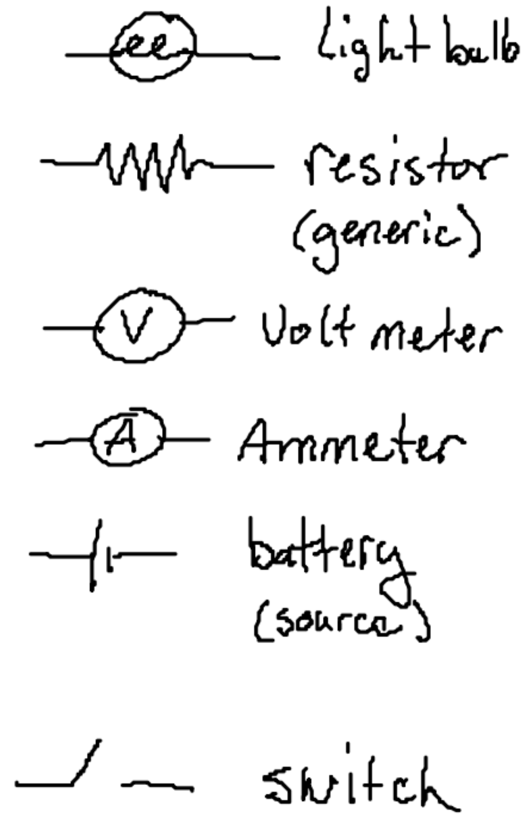


Series



Parallel





Physics Talk

What are the differences and similarities of series and parallel circuits?	
	• Series – one missing/broken bulb makes them all go out (no flow)
	• Series – only one path to each bulb
	• parallel – one missing/broken bulb does not break the whole circuit
	• parallel – multiple paths to each bulb
	• parallel – battery voltage is the same as the voltage at each resistor
	• parallel – Current at the battery is split amongst the resistors

What is the language of electricity?

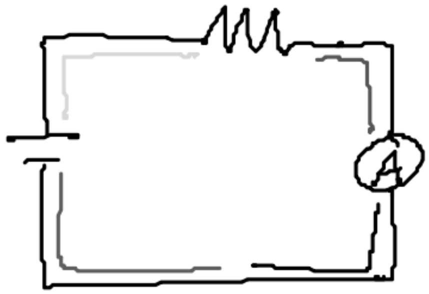
- electric charge – two kinds (+) (–)
  (+) protons (–) electrons
- like charges repel, opposite charges attract
- electrons + protons have the same amount of charge
- electrons move in electric circuits and carry the electric current
- electrons - 1.6×10^{-19} C
- 1 C ≈ 1 lightning bolt
- resistance = opposition
- copper = low resistance
  tungsten = higher resistance
  insulators = really high resistance
- resistance – Ohms Ω
- Volts – energy per Coulomb

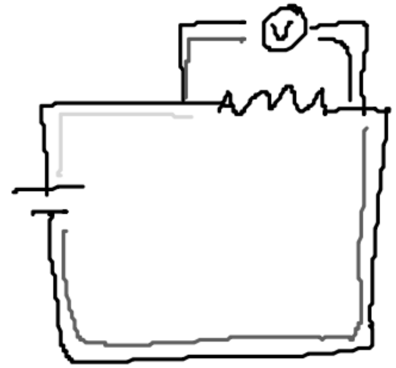
p. 618 CU #1-4
p. 619 WDYTN
pp. 621-622 PtG #1, 2, 4-6, 9, 10

6.4 Ohm's Law: Putting up a Resistance p. 623 11/1

WDYS Game show, confused "The Ohm Show"
Mystery Box
Game board shows Voltage + Current
To win the box – has to do w V + A

WDYT Brightness of lightbulb
Voltage, series or parallel circuit,
Wattage (Power)
How much current in a circuit
Power, resistance
parallel or series

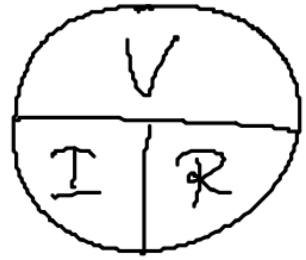




V	A

How does Ohm's law relate resistance to voltage and current?

- interact w/ world around it electrically
- increasing voltage increases current
- ratio of voltage to current is constant for any single resistor
- Most resistors obey Ohm's law
- $R = \frac{V}{I}$
- unit of resistance = Ohm Ω
- 1 Ω resistor on a 1 V battery draws 1 A of current



- Some resistors obey Ohm's law over a wide range of Voltages – R stays the same

p. 626 CU #1–3
p. 627 WDYTN
p. 629 PtG #1–4

6.5 Electric Power: Load Limit

p. 631

11/7

WDYS Circuit breaker box exploding / going crazy
A lot of things plugged into the same
outlets & all turned on (maybe not vacuum)

WDYT CB – to separate the energy througout the house
brings energy in from outside
turn on power when power goes out
Control the energy / electricity in your house

Trip – using too much electricity at the same time
- too many things on
- wrong things on at the same time

Volts matter

Too many Amps

110-120v - most outlets

220-240v - oven / A/C

Physics Talk

What is power?	• brightness of a bulb depends on how much power • power is the rate at which energy is supplied
Is there an equation?	• Power (P) = energy / unit time (J/s) or (W) watts • Voltage (V) = energy / charge (J/C) or (V) • Current (I) = charge / unit time (C/s) or (A) • P (W) = V (V) I (A) • P $\left(\frac{J}{s}\right)$ = V $\left(\frac{J}{C}\right)$ I $\left(\frac{C}{s}\right)$

What blows a fuse or trips a circuit breaker?	• designed to melt (fuse) or break open (circuit breaker) when too much current flows through
Conductor	• Conducts electricity easily • low resistance to electric current • copper + other metals, water
Insulators	• Conducts electricity poorly • Very high resistance to electric current • glass, plastic, wood, brick, air, rubber
	• Items that generate lots of heat use lots of electricity

p. 638 CU 1, 2, 3, 4
pp. 641-642 PtG 5, 6, 14

6.6 Current, Voltage, and Resistance in Parallel Circuits: Who's in Control? p.644 11/9

WDYS

- 2 girls getting mad over one having the light on and one having the light off.
- A mad dog
- ~~The 2 girls~~ 1 girl keeps turning the light on & the other keeps turning the light off from across the room
- Circuit is wired through both switches

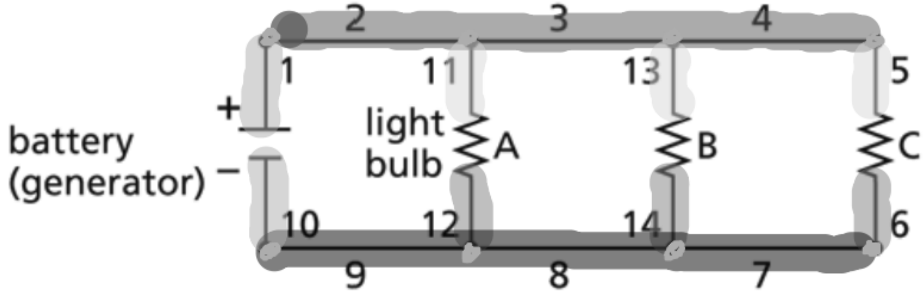
WDYT

sensored light - senses movement

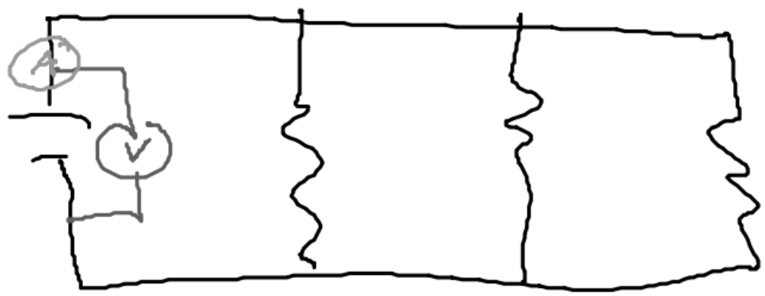
" - Senses light

thermostat - detects heat

timers


2
3
4
1
11
13
5
+
battery
(generator)
−
light
bulb
A
B
C
10
12
14
6
9
8
7


switch


A
V

Physics Talk

11/15

How do you relate Current, Voltage, and resistance in series and parallel circuits?

- Switches control which resistors in a parallel circuit get current
- Switches are always in series with the device they control
- All switches have an air gap which opens the circuit

Current in a Series Circuit

11/16

- $I_T = I_1 = I_2 = I_3$

Current in a Parallel Circuit

- Current entering a junction = current leaving the junction (9A = 3A + 6A)
- Charge is conserved
- $I_T = I_1 + I_2 + I_3$

Voltage in a series circuit

- Charge is conserved (all of it goes through a resistor)
- If the resistors are the same, they get the same amount of energy; if they have different resistances, they get different amounts of energy.
- $V_T = V_1 + V_2 + V_3$
- energy is conserved

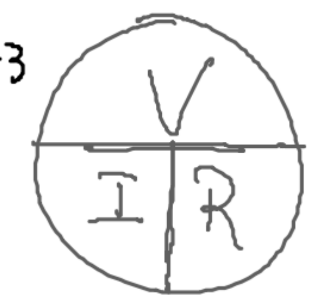
Voltage in a parallel circuit

- $V_T = V_1 = V_2 = V_3$

Resistance in series and parallel circuits

- series $R_T = R_1 + R_2 + R_3$
- parallel $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$$V_T = I_T R_T$$



p. 654 CU 1–3
p. 658-9 PtG 7, 9, 10

6.7 Law of Thermodynamics: Too Hot, Too Cold, Just Right *11/17*

WDYS 3 bears making hot chocolate

Too hot – not enough half+half

Too cold – too much half+half

Just Right – Just Right

Goldilocks in the window

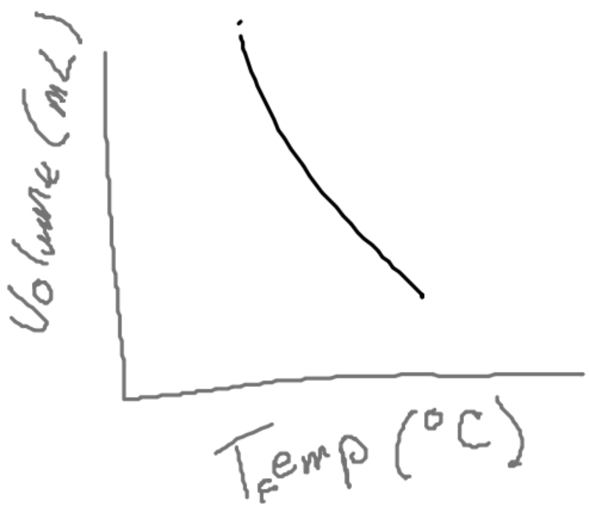
WDYT

- how much milk
- how much coffee
- how warm the coffee is to start
- stirring
- container
- environment

Temperature °C
Volume mL

Vol Hot	Vol Cold	Temp Hot	Temp Cold	Temp Mix
100 mL	100 mL			
100	50			
100				

Steps 1-3c



What is the Law of Conservation of Energy?

- Cold water gained thermal energy via the transfer of the thermal energy lost by the hot water.
- The heat energy gained by the cold water is equal to the heat energy lost by the hot water.
- The total energy change must $= \emptyset$.

equation

$$\Delta Q_h + \Delta Q_c = 0$$

$$(m_h)(T_f - T_h) + (m_c)(T_f - T_c) = 0$$

$(T_f - T_h) < 0$ $(T_f - T_c) > 0$

Water 1 mL = 1 g

Specific heat

- $c\left(\frac{J}{g\,^\circ C}\right)$
- the amount of energy required to raise the temperature of 1 g of material 1°C
- $c_{H_2O} = 4.18\ \frac{J}{g\,^\circ C}$ (high)
- $\Delta Q = mc\Delta T$ $(J) = (g)\left(\frac{J}{g\,^\circ C}\right)(^\circ C)$

$\Delta Q_{hot} = 100g\ 4.18\frac{J}{g\,^\circ C}\ (45^\circ C - 62^\circ C)$

$\Delta Q_{hot} = 418(-17)\ (J)$

$\Delta Q_{hot} = -7106\ J$

$\Delta Q_{cold} = 7106\ J$

Temperature	• a measure of the average KE of the molecules
Zeroth Law of Thermodynamics	• If $T_A = T_B$ <u>AND</u> $T_B = T_C$ Then $T_A = T_C$
	• Heat $\neq$ thermal energy
	• Thermal energy is measured via temperature and is a part of the ~~total~~ total energy of an object
	• Heat is thermal energy transferred from one object to another

The First Law of Thermodynamics	Thermo – relating to thermal energy dynamics – changes • conservation of energy WRT hot + cold objects (no energy lost) • $\Delta Q = \Delta U + W$ (work) • ΔU – change in internal energy
The Second Law of Thermodynamics	• Heat always travels from a hotter object to a colder object • entropy – restricts heat movement to one direction

p. 672 CU #1–4

p. 676 PtG #2+4

WDYS

Someone showering + cooking simultaneously
Sink, clothes washer, radiator, Coffee maker
everything's running
Hot water: sink, shower, clothes washer, radiator
guy washing truck

WDYT

Volume of water - more water, longer to warm
size of the coil - smaller is slower
type of container - some hold heat in better
Lid - holds heat in
starting temperature of the water - colder takes longer to heat
temperature of the coil

volume = 200 mL   Time = 100s

Energy Consumption	• kilowatt-hours (kWh) 1 kWh = 3,600,000 J • 1 J = 1 Ws $\Delta Q = mc\Delta T$ $E = VIt$
Efficiency	$\frac{\text{Useful energy output}}{\text{Total energy input}} \times 100$

p. 682 CU 1-4
p. 684 WDYTN
p. 689 Ptb #6

6.9 Comparing Energy Consumption: More for Your Money 12/2

WDYS

Lady in pj's looking tired, with power strip electric kettle, Kettle on hot plate, immersion coil heater, microwave, four different clock, watching her clock

WDYT

They are, because they save you money in the long run.

Microwave

Power: 900 W
Time: 120 s
Volume H_2O: 200 mL
Mass H_2O: 200 g
T_c: 15 ºC
T_f: 54 ºC

$E = Pt$

$E = 108{,}000\ J$

$\Delta Q = mc\Delta T$

$= 200(4.18)(39)$

$= 32604$

$e = 30.2\%$

Hotpot

Power: 1000 W
Time: 44.4 s
Volume H_2O: 200 mL
Mass H_2O: 200 g
T_c: 17 °C
T_f: 55 °C

$E = 44{,}400\ J$

$\Delta Q = 200(4.18)(38)$

$= 31768$

$e = 71.5\%$

Immersion Coil

Power: 300 W
Time: 185.7 s
Volume H_2O: 200 mL
Mass H_2O: 200 g
T_c: 17 °C
T_f: 54 °C

$E = 55{,}710\ J$

$\Delta Q = 200(4.18)(37)$

$= 30932$

$e = 55.5\%$

Physics Talk 12/6

DETERMINING ENERGY CONSUMPTION	- we need energy in KW, & time in hours of appliance use - electricity is at constant rate - Kwh meter measures the total electrical energy used in your home - Info on energy use of appliances from power companies or corporations that sell electrical supplies

Heat Transfer	3 ways - Mixing, heat waves, contact • Need a difference in temperature between two substances • always from warmer body to cooler body
Conduction	• requires direct contact
Convection	• physical movement of warm fluid through cold fluid
radiation	• electromagnetic radiation travels at the speed of light and is absorbed by a material

p. 695 CU 1, 3-6
pp. 698-9 PtG 1, 3, 4, 10